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Introduction

In cooperation with the Christina Basin Water Quality Management Partnership, the Delaware Nonpoint Source Program chose the Pike Creek subshed for watershed-based implementation to reduce water pollution sources and restore water quality. The Nonpoint Source program within the Department of Natural Resources and Environmental Control (DNREC), Division of Soil and Water Conservation, is a federally funded grant program directed to reduce nonpoint sources of pollution in accordance with the U.S. Clean Water Act.

This document describes anticipated and current projects intended to improve water quality within the Pike Creek watershed. Each project, designed and supervised by professionals, is linked to key sources of pollution within Pike Creek. Ongoing water quality monitoring to track the performance of individual projects as well as overall water quality of Pike Creek is an important feature of this plan. As activities within Pike Creek continue and new data are recorded, relevant revisions will be made to this watershed plan.

Under the guidance of the Christina Basin Water Quality Management Partnership, Pike Creek was identified as having a potential for urban related pollution, primarily based on the level of urban development. Ambient water quality monitoring, conducted quarterly at the base of the watershed, indicates that nutrient levels are moderate and trends are steady. General field observations, however, suggest that excess nutrients may be a concern as biological integrity is threatened due to excess sediment, stream channel instability and stream bank degradation related to stormwater runoff. Also, the relatively dense residential population contributes pollutants to the creek through their daily activities and lawn care practices.

The purpose of the Pike Creek Watershed Initiative is to reduce nutrient and bacteria levels and protect the biological integrity of the stream through technical projects and public outreach initiatives. Where development already exists, Best Management Practices (BMPs) will be implemented. Individual landowners can influence stream quality through careful management of their property. Local and state agencies are enhancing stormwater treatment through incorporating community involvement in storm drain systems. Additionally, a monitoring plan is under development that will include biological, habitat, and water chemistry evaluation to assess stream quality changes resulting from implementation.

Section 1. Watershed Setting

Section 1.1 – Watershed Characteristics

The Pike Creek watershed is located in Northern New Castle County, Delaware. Pike Creek is a first order stream, 9.4 miles in length, which flows into the larger White Clay Creek, a subbasin of the Christina River Basin. The Pike Creek watershed is approximately 6.6 square miles and is dominated by residential development. The watershed has an estimated population of approximately 20,000 inhabitants in 2000.

Population Data:

- 2000 Census data: 19,526 residents in Pike Creek
- Median Age: 36.2
- Median household income: \$71,655 (year 2000)

- Median house value: \$161,300 (year 2000)

Total households	8,201
Family households (families)	5,165
Householder living alone	2,381
Householder 65 years and over	485
Total housing units	8,415
Occupied housing units	8,201
Vacant housing units	214
For seasonal, recreational, or occasional use	42
Occupied housing units	8,201
Owner-occupied housing units	6,128
Renter-occupied housing units	2,073

Land Use Features and Characteristics:

- Mostly suburban residential with 26% impervious cover.
- Three Little Bakers Golf Course is located along the Pike Creek mainstem.
- Pike Creek has one dairy farm (76.8 Acres) and one horse farm (less than 10 acres).
- Pike Creek has two parks: Judge Morris Estate – a State-owned park (460 acres - a portion lying outside of the watershed) and Deacons Walk County Park.
- Forest cover is 13% of total area (552 acres)

Section 1.2 - Watershed Concerns

The Pike Creek watershed has several primary characteristics that lay the foundation for its management needs:

- Pike Creek is part of the White Clay Creek Wild and Scenic River System.
- According to nineteen water quality, habitat and watershed health indicators assessed under the Christina Basin Clean Water Partnership, the Pike Creek was rated a C+. ¹
- It serves as a public drinking water source-water stream, is one of the few trout-put-and-take stocked streams in the State, and provides habitat in an area of high growth and development.
- Pike Creek is part of the Christina Basin Total Maximum Daily Load (TMDL) process and is listed for nutrients, bacteria, biology and habitat.
- The watershed has 26% impervious cover; a significant portion of the extensive residential development was built prior to the 1991 State Sediment and Stormwater Regulations.

Within the suburban watershed of Pike Creek, stormwater runoff is the major source of water quality contamination. Ambient water quality monitoring, sampled quarterly at the base of the

¹ Please refer to the June 2003 Watershed Restoration Action Strategy (WRAS) for the Delaware Portion of the Christina Basin or the Executive Summary of the report, both prepared by the Partnership.

watershed, shows moderate nutrient levels and steady trends, however, general field observations suggest that excess nutrients may be a threat to the biological integrity.

Section 2. Planning Framework

In areas of high residential development, streams may be protected through sediment and stormwater regulations enforcement and conservation design techniques promotion. The Pike Creek Watershed Plan incorporates suburban restoration projects, which target nutrient, bacteria and sediment loads resulting from stormwater runoff. The projects initiated in this plan are aimed at preventing increases in and reducing, if possible, the levels of nutrient loading.

One of the most challenging aspects to those working in watershed protection is determining which areas are in the most need and what strategies will yield the most benefits to the watershed. The information included in this section is intended to highlight the watershed characteristics and present results from various analyses that were conducted and described in the Watershed Restoration Action Strategy for the Delaware Portion of the Christina Basin as well as stream tests conducted by the Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Soil and Water prior to project implementation in the Pike Creek. This suburban watershed plan develops a broad structure of goals and priorities that reflect the needs and challenges for the Pike Creek.

It is important to recognize that the goals and priorities presented here are temporary and may change over time. The value of this Watershed Action Plan will be limited unless the Pike Creek residents and organizations leading projects within the watershed communicate and work together to make revisions and improvements where possible. With that in mind, strong efforts to coordinate watershed planning, implementation, evaluation and alterations must be stressed. Of paramount importance is the data collection and analyses, followed by dissemination of this information to project leaders and Pike Creek residents. Finally, data can be used in a state of the watershed report and included in the Christina Basin Partnership reports.

Section 2. 1 - Objectives

In general, the Pike Creek watershed plan is meant to provide a framework of implementation strategies to achieve the following:

- Improve water quality
- Reduce pollutants from stormwater runoff
- Protect and restore stream banks
- Integrate municipal planning to meet future wastewater needs
- Engage and educate individuals and communities in watershed stewardship

Specifically, and in addition to the general objectives outlined above, the goals of this watershed action plan are to:

1. Prevent increases in nutrient loading and to lower levels if possible;
2. Achieve reductions or maintain stable conditions in TMDL-related nutrient concerns through improved stormwater management and residential lawncare;

3. Improve biological integrity through erosion control, stream channel stabilization, and streambank planting;
4. Increase and continue to support the Pike Creek community's residential awareness of Best Management Practices and the effects of personal behavior on watershed quality.

Section 3. Total Maximum Daily Load Regulations

A Christina Basin watershed inventory with continuous technical monitoring efforts performed under the Partnership concluded that Pike Creek's challenges are nutrient pollution (nitrogen and phosphorus), low dissolved oxygen, bacteria, and excessive sediment from a variety of point and nonpoint sources.

In 1997, Delaware and Pennsylvania consented with the U.S. Environmental Protection Agency to establish low flow and high flow TMDLs in the Christina Basin. The low flow (point source) TMDLs were issued by the USEPA in October 2002. USEPA expects to complete the high flow (stormwater) TMDLs by December 2004.²

Section 4. Implementation Partners and Activities

The following organizations are primarily responsible for the programs being implemented in the Pike Creek Watershed.

- The DNREC Nonpoint Source Program (NPS) administers a competitive grant made possible through Section 319 of the Clean Water Act. The grant provides funding for projects designed to reduce nonpoint source (NPS) pollution in Delaware.
- The DNREC Division of Water Resources operates a full-service environmental laboratory to test and assess water, air, soil, hazardous materials, and biological samples. Water quality and biological monitoring of surface waters is an important section function. Dr. Samuel Myoda of the Watershed Assessment Section performs bacteria source tracking analyses.
- The Delaware Nature Society (DNS) is the leading and largest non-profit environmental organization in this region, offering nature education for all ages, protecting and preserving natural resources, and partnering with individuals and groups interested in the environment. The Nature Society operates two nature centers, maintains four nature preserves for biodiversity, research and education, and works to preserve natural areas, open space, and farmland in Delaware.

² TMDLs are established along impaired waterways in accordance with section 303(d) of the Federal Clean Water Act. TMDLs are determined using hydrologic and hydraulic computer models according to the following equation:
TMDL = WLA + LA + FS

TMDL = Maximum amount of a particular pollutant discharged to a waterway without violating stream water quality standards.

WLA = The waste load allocation from point sources such as wastewater treatment plants during low flow conditions.

LA = Load allocation from nonpoint sources such as stormwater and agricultural runoff during high flow conditions.

FS = Factor of safety to account for imprecision in modeling and monitoring.

- The Delaware Department of Transportation (DelDOT) NPDES Program implements and administers the requirements of DelDOT's National Pollutant Discharge Elimination System (NPDES) Phase I, Phase II and industrial permits. It is a comprehensive and coordinated effort charged with improving the quality of storm water runoff from DelDOT-owned streets and facilities. This includes operation and maintenance of storm drain systems to reduce the discharge of pollution, illicit discharge investigation and remediation, BMP retrofits, spill prevention and response, pollution prevention plans for all maintenance yards, and public education and training.
- New Castle County Department of Special Services is responsible for the care and maintenance of county-owned property. Special Services staff maintains and operates all County assets, including buildings, vehicles, land, storm drains, sewer lines, and pump stations. Stormwater quality control is part of the Department's mission.
- The Partnership for the Delaware Estuary, Inc., is a non-profit organization that was established in 1996 to participate in the implementation, continued development, and update of the *Delaware Estuary Program's Comprehensive Conservation and Management Plan*. The Partnership works to protect the environment, promote conservation of the natural resources, and contribute to the usefulness of the Delaware Estuary and its tributaries for recreational and commercial purposes that are compatible with the sustainable use of estuarine resources.

Section 4.1 - Delaware Nature Society: Riparian Smartyards

Riparian "Smartyards," which entail establishing native plant species along riparian corridors, are a key strategy to stabilize stream banks, reduce stormwater runoff, filter pollutants and provide excellent habitat thereby helping to enhance the watershed for landowners and wildlife. The DNS began promoting the "Smartyards" Program in mid-2003 through the following activities:

- Contributing articles to the News Journal and DNREC's Tributary Times e-newsletter;
- Posting on the DNS webpage;
- Giving presentations to the Pike Creek Civic League;
- Sending follow-up letters to Presidents of civic associations within the watershed.

The DNS, in coordination with the DNREC Nonpoint Source Pollution staff and Jim Chaconas (DNREC Division of Water Resources) compiled the contact information for interested landowners to determine bank stability. Six registered sites were assessed. Three sites were approved for the Riparian Smartyards project and the three remaining registered sites were referred to the New Castle Conservation District for cost-share opportunities.

The three selected sites were situated on neighboring properties within the Chestnut Valley subdivision and promotion efforts were re-targeted within that community. DNS received contact information for an additional five adjoining property owners through the Chestnut Valley civic association president. Phone calls and follow-up meetings were made, which resulted in an additional enrollment of five individuals. Of the 8 properties owners in Chestnut Valley that were contacted, representatives of the project met with a total of 5 individuals to enroll them in the Riparian Smartyards project. In May, 2004, riparian plantings were installed at 18, 20, 22,

and 24 Willow Creek Lane creating a contiguous stream buffer. In addition, Chestnut Valley received riparian plantings for their community open space, adjacent to Pike Creek. Smartyards was completed in May 2004. Neighbors came together to create 500 feet of continuous stream buffer along the tributary of Pike Creek in the Chestnut Valley development.

Materials:

- A Riparian Smartyards brochure, including native plant lists and installation templates (based on existing site/buffer conditions) was provided by Denise Husband, a landscape architect with Environmental Design.
- Habitat enhancements (bird feeder, nesting box, and birdbath) were secured through Wild Birds Unlimited and rain barrels through the University of Delaware Water Resources Agency.
- Landowners were given a starter kit filled with educational and how-to resources, a water quality checklist, a habitat-planning guide and tips on attracting birds and butterflies.
- Native materials were ordered through Gateway Garden Center. Due to a stipulation in the cost-share agreement with the New Castle Conservation District, all plant materials are restoration size and quality, as opposed to what can be purchased retail.

Concluding Activities:

- On Friday, May 21, 2004, plant materials, habitat enhancements, and rain barrels were delivered to participants. DNS trained Habitat Stewards were available for technical assistance.
- Homeowners will be responsible for installing all materials following the delivery.
- Representatives from the Delaware Nature Society, New Castle Conservation District and the Delaware Department of Natural Resources and Environmental Control (DNREC) Nonpoint Source Pollution Program conducted a final inspection of the plant installation on June 10, 2004.
- Homeowners are finalizing the necessary paperwork for Backyard Wildlife Habitat certification through the Delaware Nature Society and National Wildlife Federation (NWF).

Funding:

The DNS originally proposed a \$5,000 native plant budget for ten Pike Creek residents' Riparian Smartyards. Due to the delayed timing of an EPA grant award, along with the geographic restrictions of the relatively small watershed and the necessity of adequate bank stability, only five packages were ultimately awarded. The combined plant order for the five participants totaled only \$3,500. Through consultation with DNREC Nonpoint Source Pollution staff, it was determined that the remaining \$1,500 allocated to purchase plant materials should be designated to the DNS to support riparian restoration efforts on the Mortenson Property, Burrows Run Preserve, and Red Clay Floodplain. To date, a decision has not been reached regarding the remaining funding for the five additional Backyard Habitat Starter kits and signs, birdbaths, bird feeders, nesting boxes, and brochures (\$877.10).

Section 4.2 - Delaware Nature Society Volunteer Stream Monitoring

The DNS's Volunteer Stream Monitoring (Streamwatch) is a project aimed at monitoring local streams for changes in water quality through the participation of local residents and civic organizations.³ The parameters that are being monitored include visual appearance, depth, temperature, pH, dissolved oxygen, nitrates, alkalinity, phosphates, conductivity, and flow. In addition to this, volunteers will assess the aquatic vegetation of the stream and also perform a macroinvertebrate survey.

Over the past ten years, DNS has established a Technical Monitoring program in northern New Castle County for the entire Christina Basin. Volunteers currently collect data at 38 sites on the tributaries of the Brandywine, Red and White Clay Creeks, and the Christina River. In mid 2003, DNS began promoting its Pike Creek program.

The DNS will train and maintain volunteer monitoring at four sites along Pike Creek. The approximate volunteer time commitment is one hour per month for one year. DNREC Watershed Assessment has agreed to evaluate data from the Pike Creek Streamwatch monitoring and the information will be used, at a minimum, in a "state of the watershed" report to residents.⁴

The intent is that the Streamwatch program will satisfy two functions:

1. Generate interaction and stream awareness among residents and
2. Serve as a potential first indication of chemical water quality changes in smaller tributaries, such as the Pike Creek.

Site Selection:

With the assistance of the DNREC Watershed Assessment team, the following locations were selected:

1. Pike Creek at Crossan Road,
2. Pike Creek at Hill Road,
3. Pike Creek at Granville Road and
4. Pike Creek at the bridge west of Three Little Bakers Golf Course.

The DNS secured permission for volunteers to access the selected monitoring locations. A training workshop for new Technical Monitoring volunteers was held on May 13, 2004 at Ashland Nature Center. Additional Technical Monitoring volunteer workshops are held throughout the year.

Promotion:

Volunteers were actively recruited through a number of medium: the Pike Creek Civic League, an article in the Delaware Nature Society *Watershed News*, press releases to the News Journal and Community News, and a posting on the Delaware Nature Society webpage.

³ For additional volunteer information, see www.delawarenaturesociety.org/nrc/SW/aboutstreamwatch.htm.

⁴ For most recent quarterly monitoring data, contact Delaware Nature Society – Stream Watch Coordinator.

Section 4.3 - DNREC's Three Little Bakers Stream Restoration Project

A Riparian Corridor Stream Inventory Study conducted by the Department's Whole Basin Piedmont Team in 1998-99 identified the upper Pike Creek (through Three Little Bakers Golf Course) as a segment in need of restoration. The stream has degraded aquatic habitat and contributes significant sediment loads from bank erosion evidenced by deep entrenchment, nearly vertical eroding banks and numerous mid-channel bars formed from sediment deposition. The stream corridor segment (approximately 4,200 – 4,500 feet in length) will be significantly enhanced using natural geomorphologic concepts recently implemented on the reach of Mill Creek passing through Delaware Park above White Clay Creek.

The upper Pike Creek stream restoration project assesses the watershed inputs and valley type in an attempt to change the stream's pattern, profile and dimension to accommodate input changes (e.g. inputs from urbanization) and restore stability, sediment transport, and biological function. Stream restoration returns a stream or stream reach to morphological equilibrium by reducing bank erosion and restoring sediment transport and turbidity levels to those that would occur under stable stream conditions comparable to pre-urbanization conditions. Reduction in sediment inputs to the stream will reduce suspended solids in the stream. The restoration project will also result in the planting of riparian wetland and upland vegetation which will further protect the banks, improve and maintain water quality and provide riparian habitat. The success of the project will be measured by implementing a monitoring program, which will, in part, keep track of channel changes and evaluate changes in stream health.

Timeline:

Contact Landowner: May 2000

Project Planning and Site Evaluations: Summer 2000 – Summer 2001

Letter of Commitment from Landowner: Fall 2001

Survey work: Fall 2001

Secure Design Firm: Winter 2001 –Spring 2002

Development of Conceptual Design Plans: 2002

Identify Projected Funding Needs: Spring – Summer 2002

Secure Funding: Spring 2002 – Present

Reference-Reach Field Research: 2002

Pre-biological Monitoring: Fall 2002

Finalize Plans: Summer 2003

Initiate Permitting: Fall 2003

Finalize Permitting: Spring 2004

Construction Bidding Process: Summer 2004

Construction: Late Fall – Winter 2004, 2005

Bog Turtle Assessment

As part of the permitting process with the Army Corps of Engineers, one of the commenting agencies - the U.S. Fish and Wildlife Service - requested a bog turtle assessment. On May 12th, 2004, Ms. Holly Niederriter, in coordination with DNREC's Division of Fish and Wildlife, conducted a bog turtle assessment at a site in the proximity of a historical bog turtle record. A GIS review revealed that freshwater wetlands existed on the site and soil maps indicated that some of the wetlands had (at least at one time) a soil type typically found in bog turtle habitat. A formal report was not written regarding the Phase 1 survey; however, no bog turtle habitat was

found that would be impacted by the proposed stream restoration. Since the stream is in close proximity to a historical bog turtle record, it is recommended that in-stream work should not be conducted during the peak bog turtle activity period of April 1 – June 30. This will help safe guard any turtles that might be using stream corridors to move between habitats.

Section 4.4 – DelDOT’s Storm Drain Inserts

In 2003, the DelDOT NPDES Program in collaboration with DNREC’s NPS Program installed 21 DrainPac® inlet protector inserts in the catch basins in Drummond North, a subdivision community in this watershed. This is an older single-family home community with numerous trees, so the inserts were expected to collect leaves and yard debris, especially during the fall months. The community has two major drainage pipe systems that drain areas similar in both size and land use. Both were cleaned out at the beginning of the experiment and the slightly shorter of the two was left untreated as a control for the study. Until the summer of 2006, KCI Technologies is responsible for maintaining and monitoring the inserts. It is conducting wet weather monitoring at the outfalls of the two drainage systems. In addition, KCI Technologies is monitoring the solids collected by the insert filters in order to estimate the total sediment and nutrient load that they remove. Early in 2004, UltraDrainguard® catch basin inserts, were installed in a nearby run of inlets, and both wet weather monitoring and sediment analyses are being conducted. The study will provide information on the effectiveness of various inlet protection devices in removing runoff pollutants and on their practicality in terms of maintenance issues and cost. Results will help DelDOT in its efforts to select BMPs that are appropriate for particular sites, land uses or stormwater quality problems in the state.

Insert Type	Location	Land Use Drained	Date Installed	No. of Units	Monitoring
UltraDrainguard®	Drummond North subdivision	Residential	Dec. 2003	26	Wet weather and sediment
DrainPac®	Drummond North subdivision	Residential	June 2003	21	Wet weather and sediment

Table 1. Summary of types of catch basin inserts evaluated in this study.

Installation

The stormdrain inserts were installed at various times during 2003 (Table 1). The drainage pipes and catch basins were cleaned before installation of the inserts.

The catch basin inserts that are being tested in Pike Creek include:

1. UltraDrainguard® Oil and Sediment Model (UltraTech International, Inc.) – an X-TEX geotextile sock and skirt that fits the size of the inlet opening.
2. DrainPac® (United Stormwater, Inc.) – an HDPE support basket and polypropylene filter liner custom-sized to fit the inlet.



Figure 1. Photographs of installed catch basin inserts. (a) *HydroKleen* units at the I-95 service plaza; (b) *UltraDrainguard* filters at the service plaza; (c) *DrainPac* inserts in Drummond North subdivision; (d) *FloGard Plus* units at the Wilmington Riverfront.

Results can be found in the data report, DelDOT's Evaluation of the Performance of Four Catch Basin Inserts in Delaware Urban Applications⁵.

Initial Results

The criterion for a qualifying storm event is a 72-hour dry period preceding a storm with at least 0.1 inch of rainfall. As of December 31, 2003, four wet weather events had been sampled at the DrainPac®-protected and control outfalls in the Drummond North subdivision. First flush and flow-weighted composite samples were analyzed for 50 different chemical parameters, including heavy metals, suspended and dissolved solids, oxygen demand, chloride, bacteria, petroleum hydrocarbons, BTEX, phenolics and PAHs. Some parameters were sampled only on the first flush. No volatile or semivolatile organics were detected in significant quantities, which is in keeping with the residential land use. The major contaminants detected were suspended solids (TSS) and nutrients. Small quantities of metals were detected.

Wet weather data from the DrainPac®-protected catch basins have been highly variable. Concentrations of most parameters measured in first flush samples collected from the protected run of inlets were frequently higher than in samples from the untreated control. This difference,

⁵ Walsh, et. Al. DelDOT's Evaluation of the Performance of Four Catch Basin Inserts in Delaware Urban Applications, 2004.

however, generally was not statistically significant (Wilcoxon signed rank test, $p > 0.05$). Contaminant concentrations in composite samples also were not significantly different between treated and control runs. The lack of difference in this case may be explained by the observation that most of the water flowing into the catch basins appears to bypass the DrainPac[®] filters. The catch basins in this community are grated curb inlets, and, because the DrainPac[®] units do not extend under the curb opening, water that flows into the curb opening does not get treated. For this type of inlet it is clearly desirable to have a BMP that extends under this opening so that most of the water is not bypassed.

To date, these monitoring data show no significant protective effects from the DrainPac[®] inserts. In fact, higher levels of nitrogen nutrients were often measured from the DrainPac[®]-protected outfall. Analyses of the solids collected by the DrainPac filter bags showed a preponderance of leaves and other organic matter. Microbial activity in the organic solids may act as a source of soluble nutrients in runoff that percolates through the inserts.

DrainPac[®] units, despite the relatively large size of the filter bag, filled up rapidly in this tree-lined community, particularly during the autumn leaf fall (Figure 4). The filter bags were cleaned at two-month intervals. However, in this case the units should probably be cleaned more often to prevent resuspension of the collected debris, which may also have contributed to the lack of observed difference in treated and untreated contaminant concentrations.

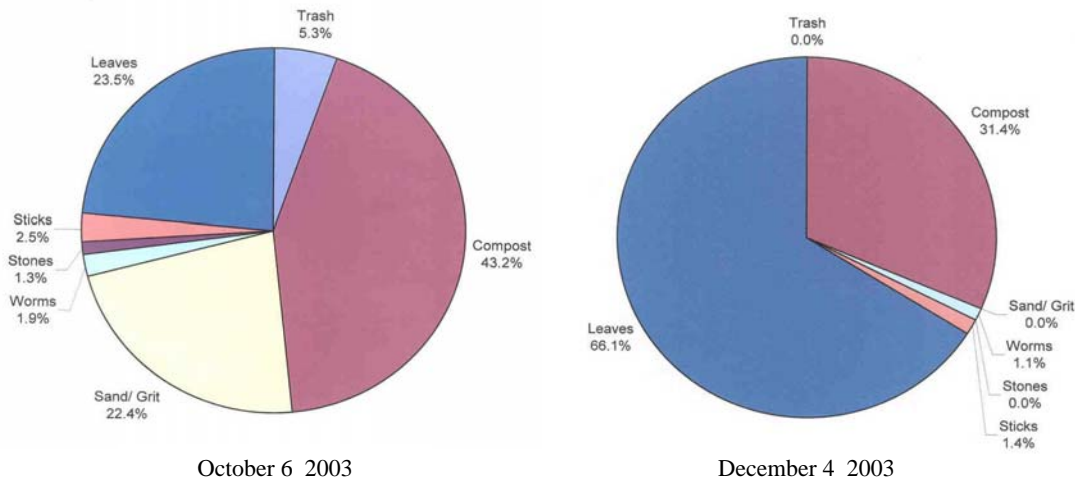
UltraDrainguard[®] inserts were installed in the Drummond North subdivision. These inserts are appealing because of their relatively low initial cost and ease of installation. However, the smaller bag size compared to other inserts may make their maintenance more burdensome in areas with heavy debris or sediment loads. The UltraDrainguard[®] filters were not installed in the Drummond North community until mid-Winter 2004. At the time, no wet weather data had been collected.

Conclusions

The limited data that we have collected to this point on the catch basin inserts highlight the variability in wet weather data, as well as in pollutant loads and the effectiveness of the inserts at removing those contaminants. Other studies have demonstrated considerable variability in field results. DeMaria et al. (2003) have discussed the challenges in acquiring proficient field data in this type of study. A Navy Environmental Leadership Program study found a 17-95% range of removal efficiencies for DrainPac inserts (NELP, 2002). A study performed by the Interagency Catch Basin Insert Committee found that a variety of catch basin inserts showed little removal of suspended solids, partially due to scouring from relatively small storms (ICBIC, 1995). A recent CalTrans study of highway BMP retrofits included several types of drain inlet inserts. The inserts performed poorly compared to other BMP types, generally providing less than 10% reduction in the concentration of most constituents. This study concluded that drain inlet inserts are best suited for gross solids removal (Currier et al., 2002; Taylor, 2002).

Catch basin inserts are attractive retrofits because of the relative ease and low cost of installation. Ultimately, however, their cost effectiveness is determined by the frequency with which they must be maintained. Our study and others have demonstrated that for many applications a very high frequency of cleaning is necessary to keep the inserts from clogging and bypassing stormwater flows, as well as resuspending captured material. Inserts may not be practical for large drainage areas or for areas with high volumes of leaves or debris that can plug them.

Section 4.5 – DelDOT’s Pet Waste Management



A program aimed at cleaning up pet wastes from yards, walkways and streets could have a measurable impact on bacteria loads to the Pike Creek. In order to assess the effectiveness of this program, the Watershed Assessment Team of DNREC performed microbial source at two stations (Brookridge and Skyline) in Pike Creek. Ribotyping analyses demonstrated that dogs are a significant source (approximately 8-12%) of fecal bacteria in the Creek.

The project includes the following three components, which are each discussed in length in the following sections:

1. Installation of four to five highly visible dog waste bag dispensers in most or all of the watershed’s residential subdivisions;
2. Collaboration with civic and homeowners’ associations to install and maintain the units over the long term and to solicit compliance from residents;
3. Assessment of the impact that this program has on Pike Creek water quality.

Installation

The dog-waste stations will consist of a pole-mounted bag dispenser (such as the “DOGIPOT Junior,” which can be seen at <http://www.dogipot.com>) and a sign that clearly indicates the purpose of the units and urges residents to be responsible pet owners. Instructions on how to

use the dispenser will be posted on each unit in order to maintain a self-explanatory system. DelDOT will purchase the materials (bag dispenser units, poles and supplies) and assist with the installation of the stations. An estimated 200 dispenser units will be needed, four or five units will be located in most or all of the 50 subdivisions in the watershed. Over a two-year period, installation of dog waste units is planned in key locations where residents are known to walk their dogs. Furthermore, in the second year, New Castle County Department of Special Services will place approximately 50 units in county-owned parks and public areas.

Collaboration with Civic Groups

For a successful program, the community must make a long-term commitment to maintain the units and refill the units with bags, as well as urge residents to use the units once they are in place. Homeowner associations and civic groups in the Pike Creek watershed will be asked to take on or assist with these responsibilities.

The Partnership for the Delaware Estuary and the New Castle County Department of Special Services, with the assistance of the DNREC NPS Program, will take the lead in approaching and working with the community groups to install and maintain the dog waste bag dispensers. Homeowner groups will be encouraged to assist with the installation of the bag dispenser units, the maintenance of the units through purchasing and installing replacement bags, and the promotion of the residents' use of these facilities.

Methods will include meetings with community leaders and politicians, presentations to community groups, and printing and mailing brochures or tip cards to residents of the Pike Creek watershed.

Evaluating Effectiveness: The Partnership for the Delaware Estuary will collect information from the residents and community leaders concerning compliance, maintenance issues and program effectiveness to ensure that the guidelines are being met within the grant period. It will be the responsibility of the participants to complete their respective projects. Upon completion of the programmatic activities, all of the participants will be mailed an evaluation form to complete and return. The evaluation forms will help assess any difficulties encountered, how the units are being used, and whether or not the community plans to continue the program.

Microbiological Monitoring:

DelDOT and the DNREC Division of Water will take water samples from two sites in Pike Creek on a quarterly basis; the samples will be analyzed for total and fecal coliform bacteria and nitrogen nutrient levels. In addition, ribotyping microbial source tracking will be used to specifically quantify the contribution of dog wastes to the fecal pollution in the Creek. The DNREC Watershed Assessment Section will perform the source tracking analyses.

The scientific complexity of the DNA technology in DNREC's bacteria source-tracking laboratory requires them to develop a matching laboratory at the University of Delaware for quality control and quality assurance purposes. With all molecular source tracking it is necessary to first build a library or database of isolates taken from known sources (e.g. human, cow, deer, etc.). New agreements with the University of Georgia and the University of Washington will allow DNREC to access their extensive libraries of genetic samples, including over 80,000 ribotyping fingerprints.

Project Timeline:

- Purchase bag dispenser stations and supplies: Nov. 2003 – Jan. 2004, Nov. 2004 – Jan. 2005
- Outreach to subdivisions & civic groups: Oct. 2003 – March 2005
- Design and printing of outreach brochures: Oct. 2003 – Jan. 2004
- Distribution of brochures to residents: Jan. 2004 – June 2005
- Installation of bag dispensers in subdivisions: Jan. 2004 – June 2005
- Installation of bag dispensers in county parks: Nov. 2004 – June 2005
- Surveys to monitor compliance: May 2004 – Sept. 2004, May 2005 – Sept. 2005
- Sampling for microbial source tracking: Quarterly through FY 2004 and FY 2005
- Reporting and publication of results: Aug. 2004 – Sept. 2004, Aug. 2005 – Sept. 2005

Budget:

The funding requested in this proposal will be used for the initial installation of the dog waste bag dispensers in Pike Creek subdivisions, however the long-term maintenance of the units will be the responsibility of the communities. The detailed budget information on the following page includes funding requested for each fiscal year from the 319 Program, in addition to the matching funds contributed by the partnering agencies⁶.

	<u>FY 2004</u>	<u>FY 2005</u>	<u>Total</u>
<i>319 Program Funds Requested</i>	\$45,200	\$24,400	\$69,600
<i>Matching Funds Provided</i>	\$31,200	\$22,450	\$53,650

⁶ At the time this plan was written, requested funding had not yet been granted.

		<u>FY 2004</u>		<u>FY 2005</u>	
		<u>Requested</u>	<u>Match</u>	<u>Requested</u>	<u>Match</u>
<u>Labor Costs</u>					
Partnership for the Delaware Estuary					
	Salaries and Benefits	6,000		4,000	
	Indirect Costs	1,500		1,000	
DelDOT					
	Salaries & Benefits (6 to 7 person-weeks)		10,500		10,500
New Castle County					
	Salaries & Benefits (3 person-weeks)		7,200		7,200
	Total Labor Costs	\$7,500	\$17,700	\$5,000	\$17,700
<u>Equipment and Supplies</u>					
	Dog waste bag dispensers (250 total @ \$90)	18,000		4,500	
	Poles and mounting hardware	2,000		500	
	Signage (provided by DelDOT)		5,000		1,250
	Total Equipment and Supplies	\$20,000	\$5,000	\$5,000	\$1,250
<u>Outreach Materials</u>					
	Design	800			
	Printing (provided by DelDOT)		5,000		
	Postage	5,000		2,500	
	Total Outreach Materials	\$5,800	\$5,000	\$2,500	\$0
<u>Laboratory Analyses</u>					
	Microbial Source Tracking (\$1,000 / sample)	8,000		8,000	
	Total Bacteria & Fecal Coliform Counts (\$100 / sample)	800		800	
	Nitrogen Panel (\$200 / sample)	1,600		1,600	
	Street Sweeper Wastes Analyses (funded by DelDOT)		2,000		2,000
	Total Laboratory Costs	\$10,400	\$2,000	\$10,400	\$2,000
<u>Administrative Costs</u>					
	Supplies, Phone, Copying, Postage, Local Travel (Partnership)	1,500		1,500	
	Supplies & Travel (DelDOT and New Castle County)		1,500		1,500
	Total Administrative Costs	\$1,500	\$1,500	\$1,500	\$1,500
<u>TOTAL REQUESTED AND MATCHING FUNDS</u>		\$45,200	\$31,200	\$24,400	\$22,450

Section 4.6 Street Sweeping

This year (2004) the DelDOT NPDES Program is beginning a program throughout the state of Delaware to monitor the effectiveness of street sweeping as a water quality BMP. Samples of waste collected from the streets by the DelDOT sweepers are being analyzed for a variety of contaminants, including total and fecal coliform bacteria. If funding for the dog waste campaign is obtained from the 319 Program, DelDOT will include wastes collected from residential streets in the Pike Creek watershed in its sweeper dirt-monitoring program. A reduced amount of dog feces in the streets should be reflected in lower bacterial counts in the street sweepings. DelDOT is providing funding for these analyses.

Section 4.7 Septic Tanks

Recently, while using DNA analysis similar to the bacteria source-tracking used to distinguish the dog waste, DNREC officials discovered that there are elevated levels of human bacteria in Pike Creek near areas served by cesspools and other outdated waste-disposal systems. It was determined that human bacteria accounted for about 27% of the organisms found in Pike Creek near North Star and Beech Hill roads, which is nearly ten times higher than state health and environmental protection standards allow. Many neighborhoods around North Star Road still drain their wastes directly into the ground using older septic systems and cesspools, which were banned from new construction in 1968.

DNREC is currently working to eliminate banned systems and improve oversight with conventional systems. Where possible, DNREC will help residents connect to central sewer systems and the state is also considering aid for those required to replace their failing systems.

Section 5. Pike Creek Phone Survey

In an attempt to determine the opinions and behaviors affecting water quality among Delaware residents who live in the vicinity of Pike Creek, a telephone survey of Pike Creek residents was conducted for the DNREC in the fall of 2003. Telephones were selected as the preferred sampling medium because of the universality of telephone ownership.

Responsive Management and the DNREC developed the telephone survey questionnaire cooperatively. Responsive Management conducted a pre-test of the questionnaire, and revisions were made to the questionnaire based on the pre-test. Interviews were conducted Monday through Friday from 9:00 a.m. to 9:00 p.m., Saturday noon to 6:00 p.m., and Sunday from 3:00 p.m. to 7:00 p.m., all local time (Responsive Management). The survey was conducted in December 2003. A total of 409 completed interviews were obtained.

The results were weighted so that the proportions of the sample among the various Census tracts matched the distribution of the population in the Census tracts in the study area. Throughout this report, findings of the telephone survey are reported at a 95% confidence interval. For the entire sample of households in the Pike Creek area, the sampling error is at most plus or minus 4.74 percentage points.

Section 5.1 Phone Survey Results

The questions were selected to measure resident awareness of the Pike Creek watershed and attitudes toward activities affecting water quality. By asking residents about their opinions and behaviors, general conclusions may be drawn concerning the potential for behavior modification and whether programs may or may not be effective in the Pike Creek. The projects previously discussed in this Watershed Plan were created prior to the survey being conducted. Thus, the survey could not be used in planning the projects, although it may serve a purpose in implementation, evaluation and future development of projects within the Pike Creek. For example, the questionnaire asked whether residents own a pet, take it on walks in the neighborhood and clean up after it. The results of the survey could assist in the future with the decision of whether or not the DogiPot project should be implemented, or if another route should be taken, perhaps verbal or written education versus waste stations.

A complete copy of the report is available.⁷ The following is a summation of responses.

Awareness of Watershed and Perception of Stream

- A slight majority of respondents (56%) indicated that a stream was within the development in which they lived, and 9% had a stream that was on or adjoined their property. Only 6% of the residents said they did not know how close the nearest stream was. 43% said they lived within two blocks of the nearest stream.
- Awareness of Pike Creek was not high among the residents. Only 13% named Pike Creek as the nearest stream; 31% said White Clay Creek; 43% said they did not know.

Water Quality in the Nearest Stream and Overall Impression of the Nearest Stream

- Thirty-one percent of residents said they did not know the water quality of the stream nearest to their residence. Thirty-eight percent rated it as good, 31% as fair or poor.
- A plurality of respondents (43%) said their general impression of the nearest stream and its surrounding area was positive; 16% said it was negative. The rest were either neutral (26%) or did not know (14%). Of those who said it was positive, their main reasons for their positive impression were that the water is clean (56% gave this answer) and the vegetation is attractive (22%). Of those who said it was negative, their main reasons for their negative impression were that the water is polluted (70%) or that it floods (25%).

Effects of Yard and Yard Management Activities on Stream Water Quality (General Questions)

- An overwhelming percentage of respondents (91%) have a yard as part of their property. Of those who have a yard, 99% said their yard area includes a lawn, 98% said the area includes trees and shrubs, 89% said it includes flower beds, and just over a third (37%) said it includes a food garden.
- Two thirds (67%) said that they take care of their lawn and landscaping themselves; 19% said they hire someone, and 15% said, “Both” (this works out to 82% who work on their lawn themselves at least some of the time and 34% who hire someone to landscape at

⁷ To obtain a complete copy of the report, contact Mark Duda at mark@responsivemanagement.com.

least some of the time). The most common lawn-care problems cited were weeds and maintaining a green lawn.

Considerations When Planning Yard Care Maintenance

- Respondents were asked about four considerations when planning their yard and associated yard-care maintenance. A highly groomed appearance had the greatest percentage answering that it was very or somewhat important (88%), followed by the cost involved (81%), then the degree of difficulty (74%) and the time involved (73%).

Fertilizers

- Nearly two-thirds of those who hire someone else to landscape/maintain their yard at least some of the time (62%) have the hired landscapers apply fertilizers and/or pesticides to the yard, and nearly an equal percentage of those who take care of their own lawn at least some of the time (60%) apply fertilizer to their lawn. The mean of the number of times that those who work on their own yard at least some of the time apply fertilizer is 2.24 times per year. Most commonly, those who apply fertilizer to their lawn do so in the spring or fall.

Disposal/Use of Grass Clippings and Other Yard Waste

- Just more than a third of respondents (35%) take care of grass clippings using a self mulching mower, while 26% use grass clippings as mulch on plant beds; 25% dispose of grass clippings in the garbage pickup.
- A substantial percentage of those who have a yard (42%) put leaves out for garbage pickup, while 25% use as mulch on plant beds and 20% compost them.
- A majority of those who have a yard (64%) put other yard waste (i.e., other than grass clippings or leaves) out for garbage pickup, while 22% compost it.

Use of Stream Banks and the Effects on Water Quality

- Most respondents did not have a stream on their property, although 7% did. Most of those who have a stream on their property leave the stream bank in a natural state, but 24% maintain the stream bank. When asked to characterize the stream bank on their property, the overwhelming majority (78%) said the stream bank is left in a natural state.
- Respondents were asked about seven possible hindrances to their planting a border along the stream on their property. The top answers of major hindrances were that a border would block the view of the stream (20%), the cost involved (19%), or having to rake leaves (15%).
- Not knowing how to choose plants or not knowing where to get plants were the top items deemed not to be a hindrance.

Management of Stormwater Runoff

- While 37% of respondents said that their neighborhood contains no stormwater structures and 22% did not know, 17% identified storm drains/sewers/gutters, 13% identified stormwater ponds, and 9% identified swales.
- Of those who indicated that their neighborhood contains a stormwater structure, nearly half (46%) said that their county maintains them.

- Respondents most commonly thought that stormwater flows directly into local streams (48%), followed by those who thought stormwater runoff is collected and sent to the wastewater treatment plant (21%).
- Respondents were asked about whether they support eight items or actions relating to water quality. The items/actions that topped the list were constructed wetlands (73% strongly or moderately supported), limiting paved areas (65%), stormwater ponds/basins (63%), and rain gardens (62%).
- Respondents were asked about four possible actions that they could take that would help protect water quality. None of the actions had a majority saying that they would be very or somewhat likely to do the action. The top actions were adopt a storm drain (42% would be very or somewhat likely to do this) and install a rain barrel to catch roof runoff (42%), followed closely by wash their car at a carwash instead of at their property (41%). Sweep the curb was the last action (38%). The action that respondents most commonly already do is adopting a storm drain (10% do this) and installing a rain barrel to catch roof runoff (also 10%).
- Roughly two-thirds of respondents (67%) said that they would be willing to pay \$2 per month to pay for necessary improvements to stormwater runoff facilities to protect water quality; 19% would not be willing.

Car Washing and Water Quality

- A plurality of respondents (46%) wash their car at a carwash only (i.e., never at home). The next most common answer is that they wash their car both at a carwash and at home (29%); 23% wash their car exclusively at home. A majority of those who do not wash their car exclusively at a carwash would be likely to wash their car at a carwash if they received reduced-cost coupons to do so.

Effect of Pets on Water Quality

- A little more than a fifth of respondents (21%) own a dog that they take on walks through their neighborhood. The overwhelming majority (91%) of those who own a dog, which they walk through their neighborhood clean up their pet's waste on the walk. Despite this high percentage that already clean up after their dog, 77% said that they would be more likely to clean up their pet's waste if facilities were provided (including pet waste bags) along the route.

Sewer and Septic Systems and their Effects on Water Quality

- A very large majority of respondents (83%) indicated that their residence is on a sewer system; 15% said their residence has a septic system, a cesspool, or a seepage pit. Of those not on a sewer system, 42% would like to be on one, while 31% do not wish to be on one. Those not wishing to be on a sewer system cited the cost of switching or the water or sewage fees; however, if the cost of switching to a sewer system were partially defrayed, 60% said that they would be more willing to switch.
- Most respondents (66%) strongly or moderately agreed that owners of an on-site system (e.g., a septic system) should be required to fix problems with the system, possibly at their own expense, if it were shown that the system does not meet state standards and that water quality was being negatively affected by the on-site system. If homeowners had to pay only part of the cost of fixing the aforementioned problem themselves, an even greater percentage agreed (76%) that homeowners should be required to fix the problem.

Causes of Water Pollution

- Respondents were asked how much nine potential types of water pollution contribute to pollution of the stream nearest their residence. Thirty-two percent said that lawn chemicals contributed a great deal, followed by discharges from industrial facilities (26%), soil erosion from disturbed areas (18%), erosion of stream banks (16%), followed by animal manure, municipal wastewater discharge, and on-lot septic systems (each at 14%). These responses indicate some lack of understanding of the major sources of pollution in the Pike Creek watershed where industrial sources are not an important factor. When “a great deal” and “a moderate amount” response categories were combined residents ranked lawn chemicals (67%), followed by soil erosion from disturbed areas (47%), erosion of stream banks (44%), trash (40%), and industrial discharge (38%) as the top five contributors. Pet waste (33%) and on-lot sewage disposal (26%) ranked sixth and seventh respectively.
- These responses indicate that residents are aware of the pollution caused by lawn chemical use and by land disturbance and stream channel erosion, but that awareness of pollution from pet waste and on-lot sewage disposal systems needs to be raised as water quality data indicate that these are both important sources of pollution in the watershed.

Public Input to Help Shape Stream and Water Quality and Ways to Provide Information to Respondent

- Two-thirds (67%) would be interested in providing input to the DNREC regarding stream and water quality protection strategies.
- Regarding effectiveness of mediums to provide information to the respondent regarding water quality and ways to protect water quality, the greatest percentage of respondents said the following would be very or somewhat effective ways to provide them with information:
 - Civic association newsletters (79%), newspapers (79%), brochures mailed to the respondent’s house (78%), TV (77%), radio (75%), and schools (74%).

Opinions on General Statements about Natural Resources

- Respondents were asked about whether they agreed or disagreed with three statements about natural resources. A majority agreed (81%, with 57% strongly agreeing) that plants and animals have as much right to exist as humans do; lower percentages agreed that humans have the right to modify the natural environment to suit their needs (49%, with 12% strongly agreeing) or that humans were meant to rule over nature (39%, with 15% strongly agreeing). These responses indicate that, in general, residents tend to hold pro-environmental values.

Neighborhood Association Membership, Demographic Data and Housing Data

- A large majority of respondents (69%) were part of a neighborhood association.
- A majority of respondents (78%) lived in a single-family house.
- The overwhelming majority of respondents (83%) own their home.
- A plurality of respondents (43%) indicated that their home is more than 30 years old.

Section 6. Recommendations

- Create a Pike Creek Watershed Leadership Committee. It is suggested that those heading projects in the Pike Creek watershed under the EPA 319 grant meet quarterly to update one another as well as show supportive efforts towards any plausible coordination of activities or press. This could (potentially) grow to be a stakeholder committee engaging residents and political leaders within the Pike Creek watershed.
- Recruit a Watershed Coordinator(s). This coordinator would be the central unit to the multiple projects; organize quarterly meetings; record and relay the minutes; compile and incorporate updated data into the Pike Creek Plan. It is suggested that this coordinator have some experience in watershed initiatives.
- Create a Pike Creek Watershed Website that describes and updates projects within the watershed. Include on the website: up-to-date water quality monitoring data and a map of all locations of Riparian Smartyards, Volunteer Monitoring sites, Drainpac, DogiPots and stream restoration segment. This map creates visual conceptualization of all the efforts within the watershed, and (perhaps) generates future participation.
- The website should include contact information so that residents know whom to contact for involvement. The site should also suggest behaviors aimed at water conservation and protection and a “Water Fact or Watershed Facts” section, which would be updated or added to monthly.
- Establish Public Communication Channels: Marketing should continue through and with the Civic League and homeowner associations. Introducing a “WaterWorks” section in the (already) produced Civic League newsletters would be an optimal method for advertising to those in Civic Associations. Advertise and publicize events in homeowner newsletters and area newspapers.
- Postcard mailings: Include simple visual cause and effect pictures: for example, illustrate trash near or in a stormdrain and a dirty river and/or pet waste and a figure indicating the percentage of bacteria in the stream. It is important that outreach methods are simple and to the point.
- Demonstrate environmentally sound yard care practices and provide composters and rain barrels for residents to purchase at the annual (September) Pike Creek Community Day. Provide literature on all Pike Creek events. Posters could be highly effective as well.
- Consider creating and implementing a student outreach watershed program in Independence Middle School, located within the Pike Creek watershed.
- Consider posting signs throughout the Pike Creek watershed, delineating volunteers monitoring sites, Riparian Smartyards sites, and stream facts along the stream in Judge Morris Park.

APPENDIX A: CONTACT INFORMATION

Organization: Delaware Nature Society (DNS)

<i>Project Name</i>	<i>Location</i>	<i>Problem</i>	<i>Participants</i>	<i>Timeframe</i>	<i>Materials</i>
Riparian Smartyards	Chestnut Valley, Red Clay Floodplain, Burrows Run Preserve & Mortenson Property	Streambank erosion and instability	DNS, DNREC, & Homeowners	May 2004 (delivery of materials) – Oct. 1, 2004 (completion of project)	Native plant lists, rain barrels, habitat enhancements, native plants
Stream Watch	Pike Creek at Crossan Rd, Hill Rd, Granville Rd & the bridge west of 3 Little Bakers Golf Course	Degraded local streams	DNS, DNREC, & community volunteers	Testing performed on a monthly basis	Testing kits for nitrates, dissolved oxygen alkalinity, pH, phosphates and conductivity

Contacts

Riparian Smartyards & Stream Watch:

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Backyard Habitat Coordinator
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Jen Gochenaur
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StreamWatch Coordinator
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Stream Watch:

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Water Assessment Section
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Hassan Mirsajadi
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Organization: Delaware Department of Transportation (DelDOT)

<i>Project Name</i>	<i>Location</i>	<i>Problem</i>	<i>Participants</i>	<i>Timeframe</i>	<i>Materials</i>
Pet Waste Management Campaign	Communities within Pike Creek Watershed	TMDL for nutrients & bacteria (fecal coliform contamination)	DNREC, DelDOT, Partnership for the Delaware Estuary, & civic groups & community members		DogiPot®
Retrofits (with DNREC NPS Program)	Drummond Hill, I-95 Rest area (Newark), & Wilmington Riverfront	Nutrient, bacteria & sediment loads	DelDOT, DNREC, KCI Technologies & RK&K Consulting Engineers		Drainpac® Ultraguard® Flo-Gard+Plus® & HydroKleen®

Contacts

Pet Waste Management Project:

Partnership for the Delaware Estuary, Inc.
400 West Ninth Street, Suite 100
Wilmington, DE 19801

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Executive Director
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Delaware Dept. of Transportation
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Stormwater Retrofit Project:

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RK&K Consulting Engineers
81 Mosher Street
Baltimore, MD 21217

Patrick DiNicola and Ron Gneo
Phone: (410) 728-2900
Fax: (410) 728-2992

Organization Name: DNREC

<i>Project Name</i>	<i>Location</i>	<i>Problem</i>	<i>Participants</i>	<i>Timeframe</i>	<i>Materials</i>
Stream Restoration	Three Little Bakers Golf Course	Severe degradation of urban stream	DNREC	May 2000 – Late Fall/Winter 2004/05	

Contacts

Stream Restoration:

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Dover, DE 19904**

**DNREC
Division of Water Resources
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Dover, DE 19904**

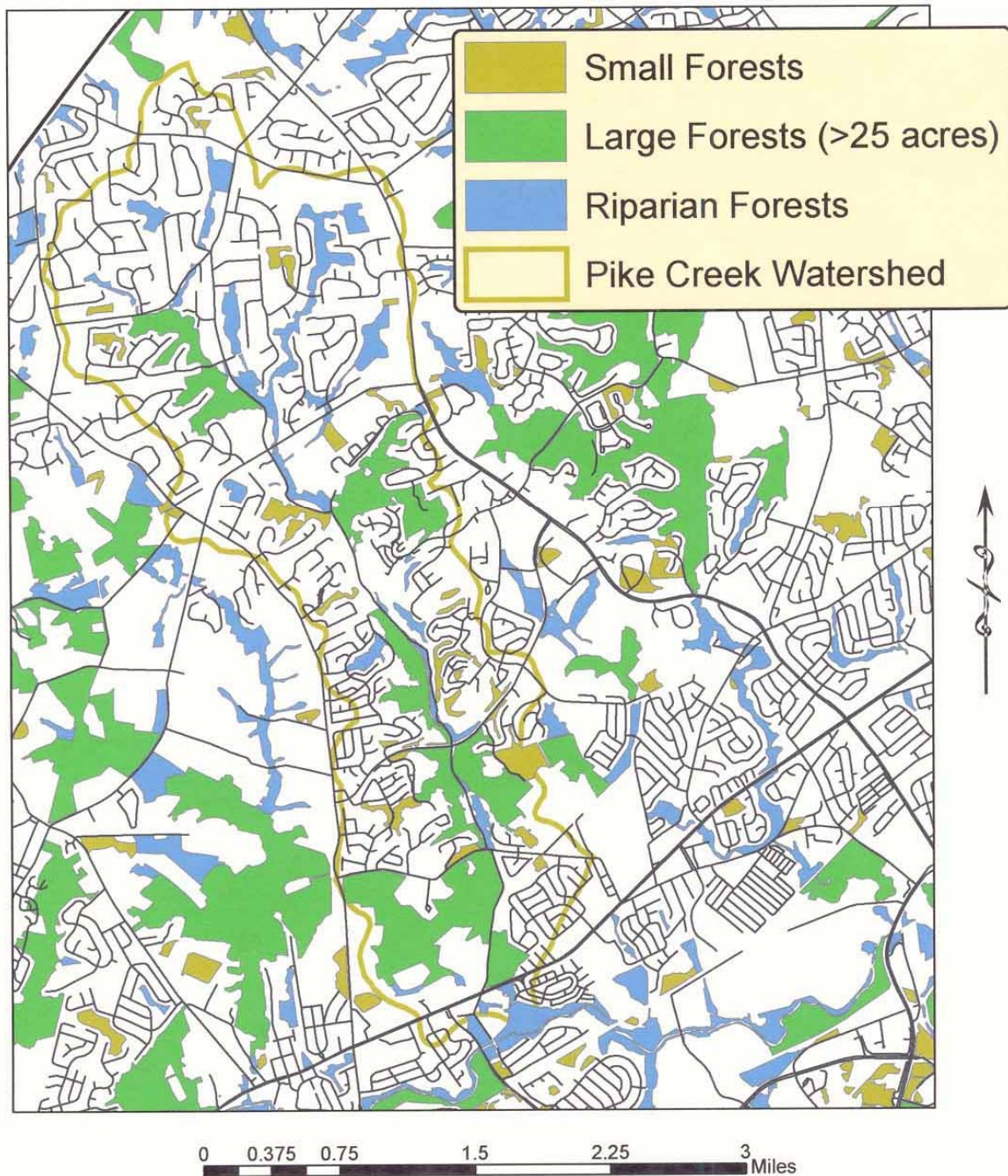
Steven N. Williams
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Phone: (302) 739-4403
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Email: Laura.Herr@state.de.us

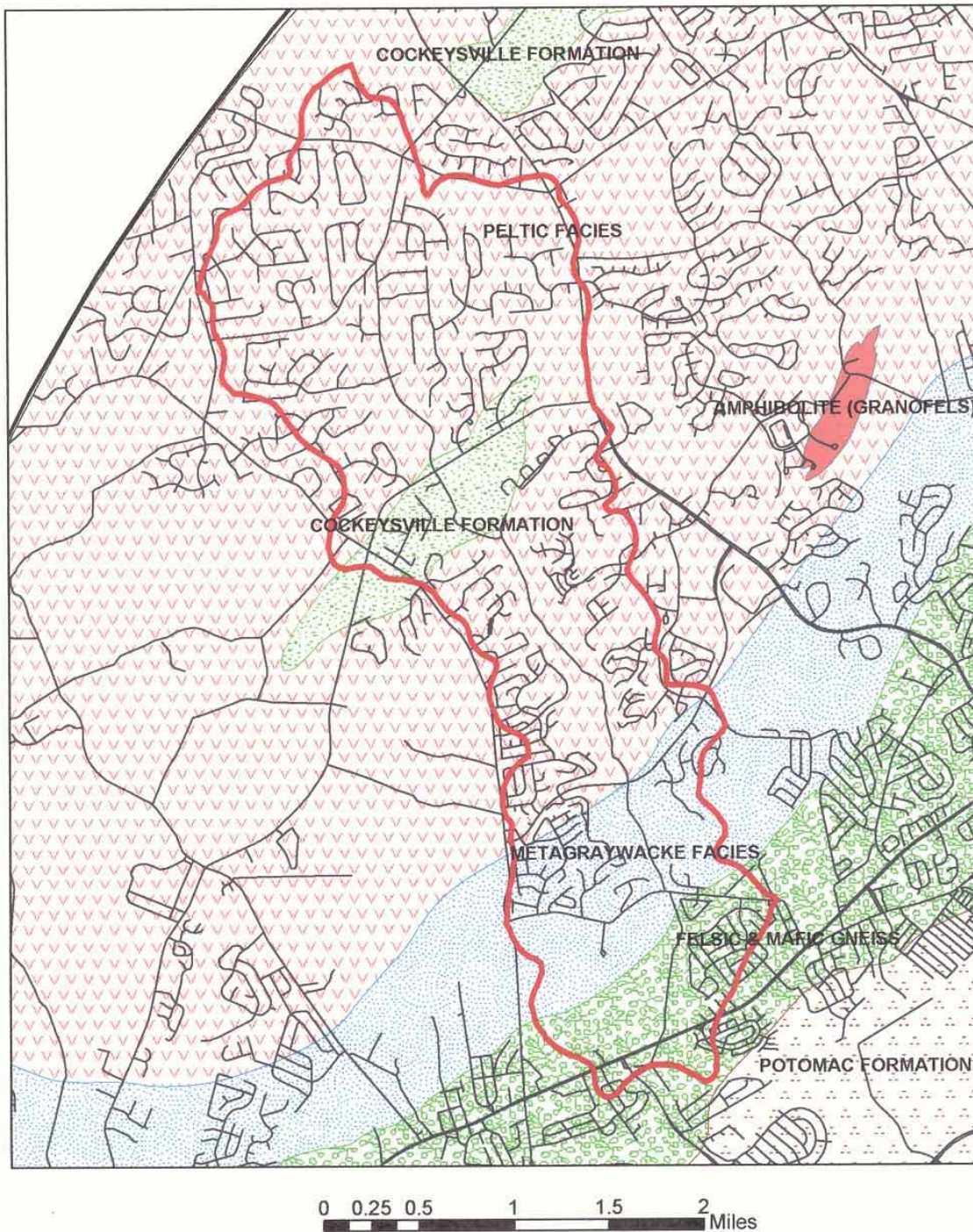
James T. Chaconas
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APPENDIX B – FIGURES

Pike Creek Watershed Forest Cover

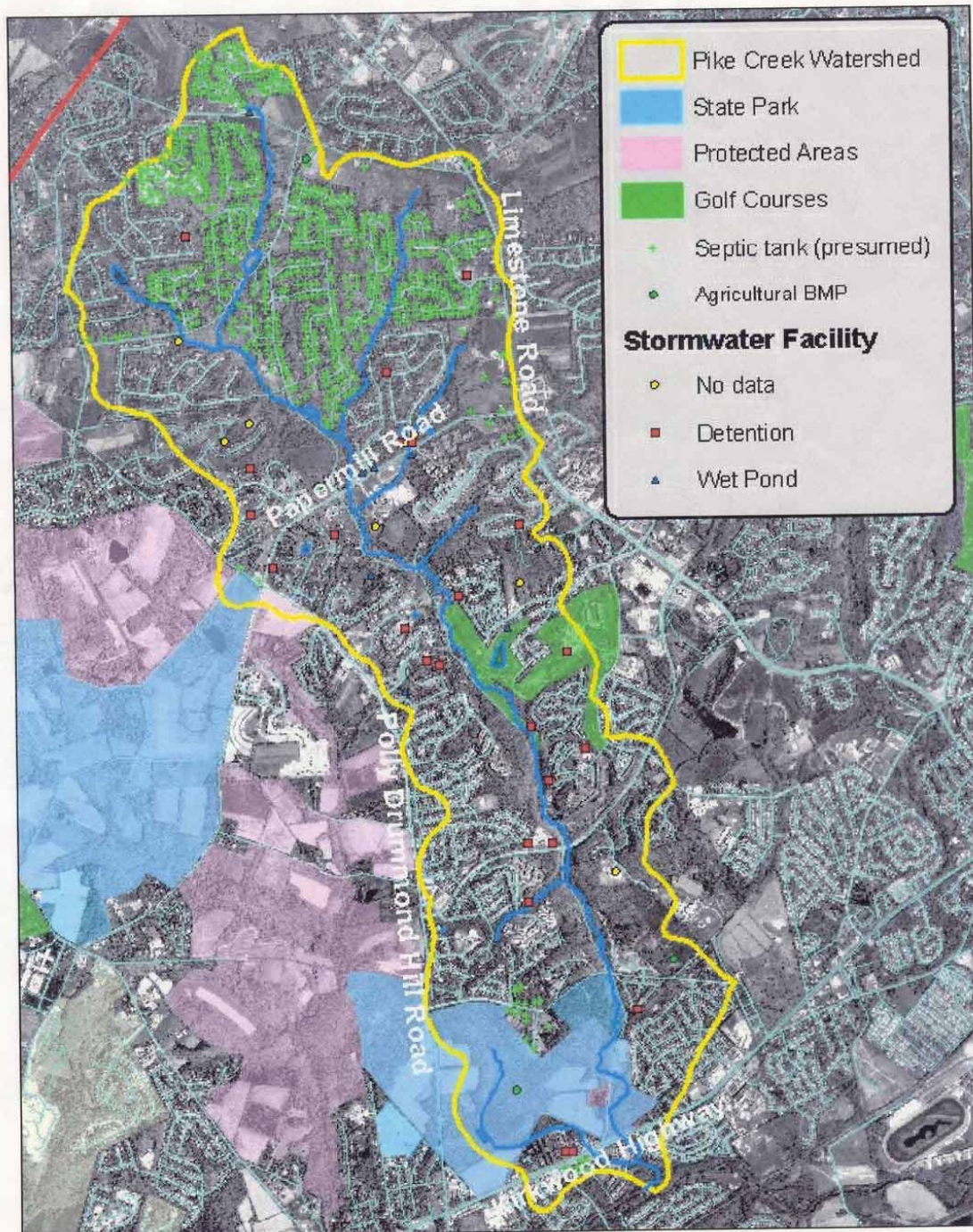


Pike Creek Watershed Geology

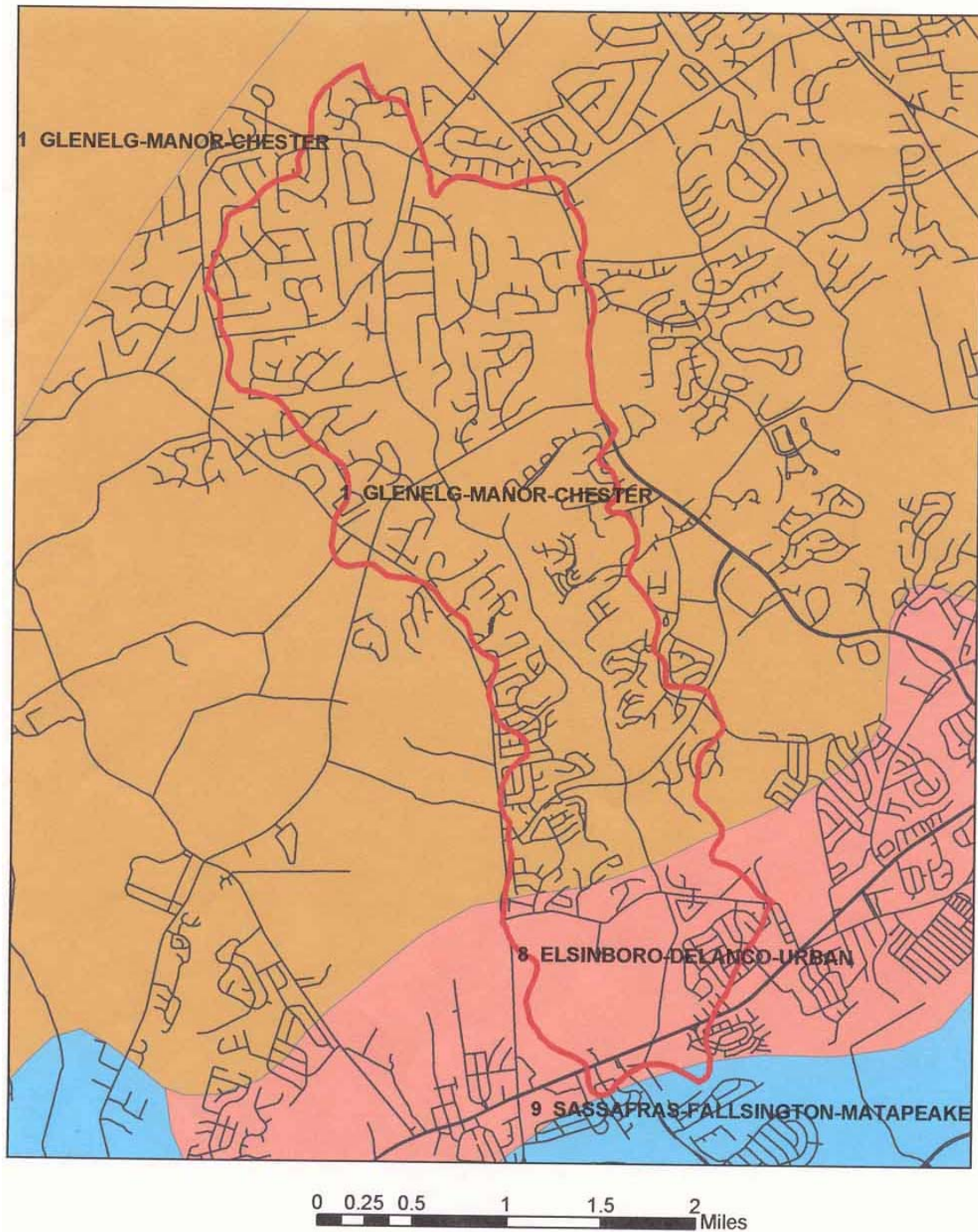


Pike Creek Watershed

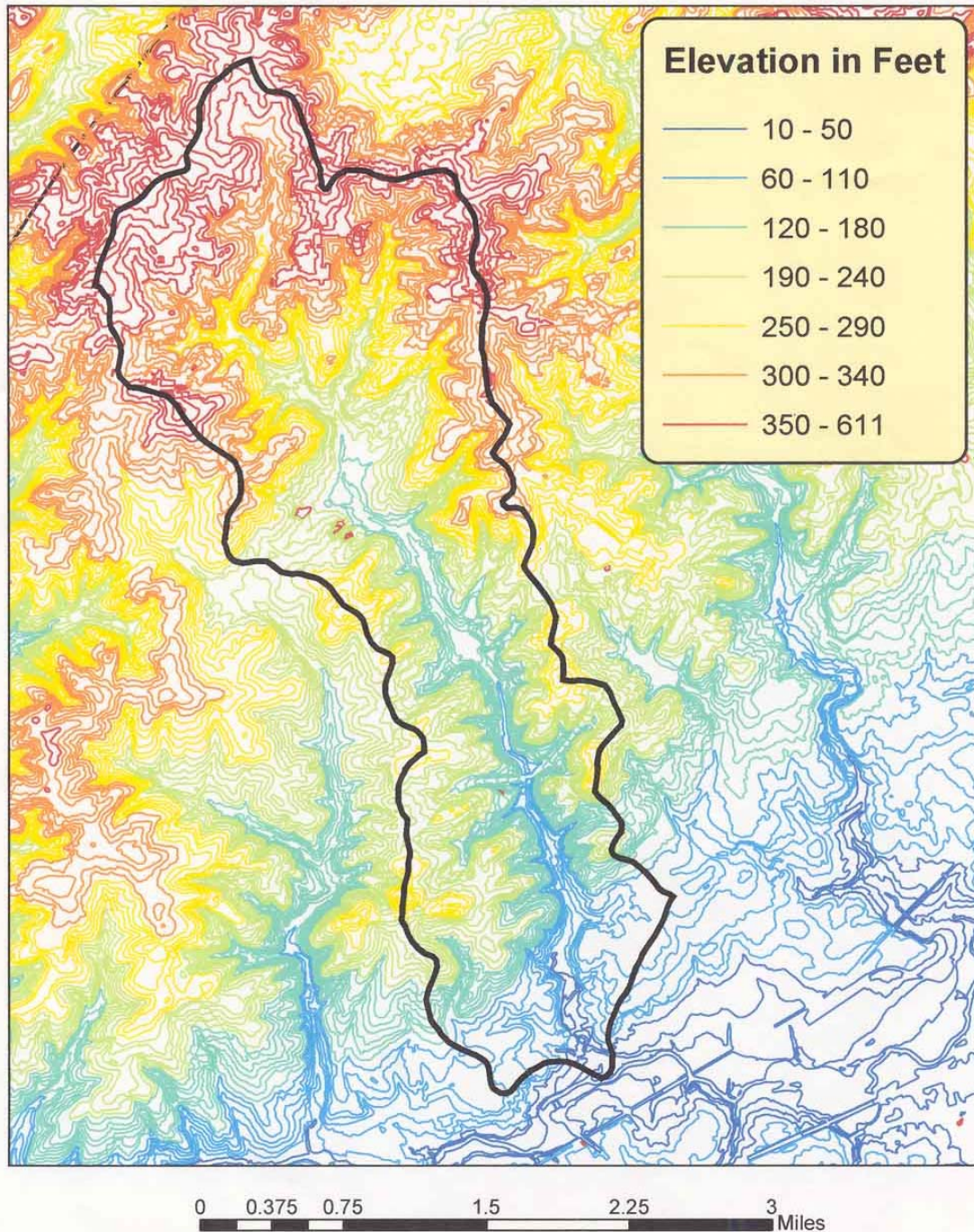
Stormwater, Septic, and Agricultural BMPs



Pike Creek Watershed Soils



Pike Creek Watershed Topography



Pike Creek Watershed WRAs

